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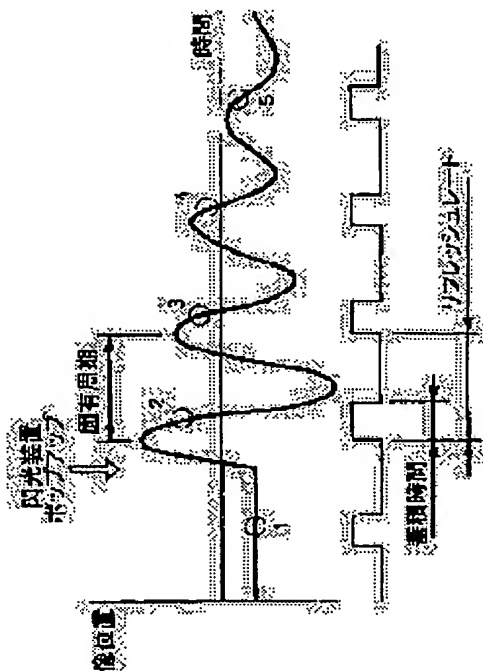
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(54) BLUR CORRECTING PHOTOGRAPHIC DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a blur correcting photographic device which is reduced in power consumption by not performing holding control over a blur correcting lens to a fixed position as much as possible when no blur correcting operation is performed even if a lock mechanism is not provided and eliminates unnatural vibration of an image displayed in a liquid crystal finder or on a liquid crystal monitor, etc., when vibration is conducted owing to mechanical disturbance.

SOLUTION: The natural vibration frequency f_n of a movable part of a blur correction unit and the refreshing rate f_r of the liquid crystal monitor 13 are so related that $|\frac{f_n}{f_r} - n| \leq 5$ (n : natural number). On condition that the natural vibration frequency f_n and refreshing rate f_r are in this relation, the image displayed on the liquid crystal monitor 13 does not vibrate unnaturally even if the blur correcting lens 1 vibrates, for example, when a flash light unit pops up, thereby giving no feeling of physical disorder to a photographer.



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CLAIMS

[Claim(s)]

[Claim 1] The Bure amendment optical system which forms a part of photography optical system [at least], and amends Bure in the image pick-up side of photography equipment, The supporter which supports said Bure amendment optical system, and the optoelectric transducer which carries out photo electric conversion of the photographic subject image obtained according to said photography optical system, The display which displays the image obtained by said optoelectric transducer, and said optoelectric transducer and/or said display are controlled. The renewal control section of an image which determines the renewal frequency of an image at the time of said photo electric conversion and/or said display, When are ***** Bure amendment photography equipment, said renewal frequency of an image is set to f_r (Hz), the resonant frequency of the vibration system which consists of said Bure amendment optical system and said supporter is set to f_n (Hz) and the natural number is set to n | The Bure amendment photography equipment characterized by having the relation of $|f_n - f_{rxn}| \leq 5$.

[Claim 2] The Bure amendment optical system which forms a part of photography optical system [at least], and amends Bure in the image pick-up side of photography equipment, The supporter which supports said Bure amendment optical system, and the optoelectric transducer which carries out photo electric conversion of the photographic subject image obtained according to said photography optical system, It is Bure amendment photography equipment equipped with the display which displays the image obtained by said optoelectric transducer. Said display Predetermined time amount including the time of an impact being added into the sequence of Bure amendment photography equipment, the Bure amendment photography equipment characterized by indicating said display to the display corresponding to an impact.

[Claim 3] It is Bure amendment photography equipment which said display displays the same image data as said display as said display corresponding to an impact in Bure amendment photography equipment according to claim 2, or is characterized by disappearing a display.

[Claim 4] In Bure amendment photography equipment according to claim 2, said optoelectric transducer and/or said display are controlled. When it has the renewal control section of an image which changes the renewal frequency of an image at the time of said photo electric conversion and/or said display, the resonant frequency of the vibration system which consists of said Bure amendment optical system and said supporter is set to f_n (Hz) and the natural number is set to n The renewal control section of an image is Bure amendment photography equipment characterized by displaying the output from said optoelectric transducer on said display as said display corresponding to an impact with the renewal frequency f_r of an image (Hz) which fills $|f_n - f_{rxn}| \leq 5$.

[Claim 5] It is Bure amendment photography equipment characterized by to include at least one of the power-up points of said photography equipment at the focus actuation time by said photography optical system at the focal distance modification time by said photography optical system the time of the flash equipment with which said photography equipment is equipped popping up, when said impact joins any 1 term from claim 2 to claim 4 in the Bure amendment photography equipment of a publication.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the Bure amendment photography equipment which takes a photograph by amending Bure of an image by moving some or all of a taking lens among the so-called digital still cameras etc.

[0002]

[Description of the Prior Art] In order to amend Bure of the image photoed with a camera in recent years, the deflection of a camera is detected, and in accordance with the deflection of a camera, the technique which amends image Bure on a film plane is being established by moving some lenses. Drawing 11 is a conceptual diagram about the deflection of a camera. The deflection of a camera consists of pitching yawing rolling motion which is rotation of three degrees of freedom, and movement of the X-Y and the Z direction which is the translational motion of three degrees of freedom, and has a total of six degrees of freedom. Usually, Bure amendment is performed to movement of two degrees of freedom of pitching yawing.

[0003] The Bure compensator is equipped with the angular-velocity sensor 101, CPU102, the electrical-potential-difference driver 103, VCM104, and optical location detection equipment 105 grade. In addition, although this Bure compensator is equipped with two control systems of pitching yawing, since it is the same configuration, by drawing 8, the suffix of p and y is attached and it gives common explanation.

[0004] The angular-velocity sensor 101 is a sensor which supervises deflection movement of a camera, the angular-velocity meter of the piezo-electric oscillating type which usually detects the Coriolis force produced by rotation is used for it, and two pieces, a total of 101 angular velocity p for pitching deflection detection and a total of 101 angular velocity y for yawing deflection detection, are being used for it.

[0005] CPU102 is a part which performs processing which changes into the target-position information on the Bure correcting lens 1 the output by which the angular-velocity sensors 101p and 101y were quantized. this target-position information — the electrical-potential-difference drivers 103p and 103y — using — the electromagnetism of the Bure amendment unit — it inputs into VCM(s) (voice coil motor) 104p and 104y which are mechanical components, and the Bure correcting lens 1 is moved so that Bure may be amended.

[0006] The optical location detection equipments 105p and 105y are parts which supervise the location of the Bure correcting lens 1, and the output is inputted into CPU102 and used for drive control of the Bure correcting lens 1.

[0007] The above configurations can amend blurring by driving the Bure correcting lens 1 according to a deflection.

[0008] By the way, in recent years, the so-called digital still camera (following, DSC) using an optoelectric transducer as an image sensor has spread not using a film. In DSC, it is common to have the liquid crystal finder and the liquid crystal display monitor, and the power used for data processing of an image etc. is also large, and its power consumption is large. Therefore, in DSC, the battery life became a problem in many cases, the cell was lost by about 100 shots in many cases, and to lessen power consumption was desired.

[0009] Moreover, since image pick-up side size is small as compared with the conventional silver salt format in DSC, the image circle of optical system also becomes small and the miniaturization of the component of a lens-barrel is possible, the demand of a miniaturization is also very strong to DSC.

[0010] The demand of the Bure amendment is [as opposed to / on the other hand / DSC] also strong. With high scale-factor-ization, in DSC, this is because a scale factor can be freely gathered by the image processing (the so-called digital zoom), for example, carries out a zoom 8 times optically, and may be further expanded by the digital zoom. Therefore, possibility of starting blurring by the long focus side is higher. In such a long focal camera, the Bure amendment technique is indispensable and the above Bure compensators came to be built into DSC.

[0011] Conventionally, the lock device for holding the Bure correcting lens to a position mechanically was needed for the Bure amendment unit for the Bure amendment interchangeable lenses. This is because there is possibility that the Bure amendment interchangeable lens can be attached to a camera without current supply capacity and the location of the Bure correcting lens becomes unfixed in that case. Moreover, the lock device was required, in order to prevent that the location of the Bure correcting lens becomes unfixed similarly when not operating the Bure amendment function even if it is a camera corresponding to the Bure amendment interchangeable lens.

[0012]

[Problem(s) to be Solved by the Invention] However, when the lock device of the Bure correcting lens was established, it became difficult to miniaturize the component of a lens-barrel and there was a problem that a camera was enlarged. When it was DSC which cannot perform lens exchange as which a miniaturization is required especially, by establishing a lock device, a miniaturization could not be attained but it was a problem.

[0013] Here, temporarily, when the lock device of the Bure correcting lens is abolished, since the Bure correcting lens is driven to the Bure amendment authorized state (condition of the Bure amendment ON) to which the Bure amendment actuation is permitted, the location of the Bure correcting lens does not become unfixed and there is no problem in it. however, in the state of the Bure amendment disapproval which does not permit the Bure amendment actuation (condition of the Bure amendment OFF) If a lock device is abolished, the location of the Bure correcting lens cannot become unfixed, and cannot satisfy desired optical-character ability upwards at the time of photography, and When the Bure correcting lens had vibrated according to mechanical disturbance etc., the image which vibrated will be displayed on a liquid crystal finder, a liquid crystal display monitor, etc., and there was a problem of giving a photography person sense of incongruity.

[0014] For example, with the camera of the gestalt of which the light-emitting part of flash luminescence equipment jumps out (it pops up), there was a problem that the Bure correcting lens vibrated at the time of pop up, and the image currently displayed on the liquid crystal finder, the liquid crystal display monitor, etc. vibrated. It always energizes to VCM and the technique of carrying out maintenance control of the Bure correcting lens in a fixed location can be considered so that the Bure correcting lens may not move in order to avoid these problems for example.

[0015] However, since it always energizes to VCM in order to always hold the Bure correcting lens in a fixed location, great power will be needed and it will lead to the fall of a battery life. As stated previously, in DSC, power consumption needed to be lessened as much as possible, and it was difficult to always carry out maintenance control of the Bure correcting lens in a fixed location.

[0016] The technical problem of this invention is offering the Bure amendment photography equipment with which the image currently displayed on the liquid crystal finder, the liquid crystal display monitor, etc. does not vibrate unnaturally, when power consumption is lessened, without performing maintenance control to the fixed location of the Bure correcting lens as much as possible when not performing the Bure amendment actuation and vibration is transmitted according to mechanical disturbance, even if it is the case where it does not have a lock device.

[0017]

[Means for Solving the Problem] This invention solves said technical problem with the following solution means. In addition, although the sign corresponding to the operation gestalt of this invention is attached and explained in order to make an understanding easy, it is not limited to this. Namely, the Bure amendment optical system which invention of claim 1 forms a part of photography optical system [at least] (L1-L4), and amends Bure in the image pick-up side of photography equipment (1), The supporter (2) which supports said Bure amendment optical system, and the optoelectric transducer which carries out photo electric conversion of the photographic subject image obtained according to said photography optical system (21), The display which displays the image obtained by said optoelectric transducer (13), The renewal control section of an image which controls said optoelectric transducer and/or said display, and determines the renewal frequency of an image at the time of said photo electric conversion and/or said display (102a), When are ***** Bure amendment photography equipment, said renewal frequency of an image is set to f_r (Hz), the resonant frequency of the vibration system which consists of said Bure amendment optical system and said supporter is set to f_n (Hz) and the natural number is set to n | It is Bure amendment photography equipment characterized by having the relation of $|f_n - f_{rxn}| \leq 5$.

[0018] The Bure amendment optical system which invention of claim 2 forms a part of photography optical system [at least] (L1-L4), and amends Bure in the image pick-up side of photography equipment (1), The supporter (2) which supports said Bure amendment optical system, and the optoelectric transducer which carries out photo electric conversion of the photographic subject image obtained according to said photography optical system (21), It is Bure amendment photography equipment equipped with the display (13) which displays the image obtained by said optoelectric transducer. Said display It is Bure amendment photography equipment characterized by giving predetermined time amount including the time of an impact being added into the sequence of Bure amendment photography equipment, and an indication of said display to the display corresponding to an impact.

[0019] Invention of claim 3 is Bure amendment photography equipment characterized by for said display (13) displaying the same image data as said display as said display corresponding to an impact, or disappearing a display in Bure amendment photography equipment according to claim 2.

[0020] Invention of claim 4 controls said optoelectric transducer (21) and/or said display (13) in Bure amendment photography equipment according to claim 2. When it has the renewal control section of an image (102a) which changes the renewal frequency of an image at the time of said photo electric conversion and/or said display, the resonant frequency of the vibration system which consists of said Bure amendment optical system and said supporter is set to f_n (Hz) and the natural number is set to n The renewal control section of an image is Bure amendment photography equipment characterized by displaying the output from said optoelectric transducer on said display as said display corresponding to an impact with the renewal frequency f_r of an image (Hz) which fills $|f_n - f_{rxn}| \leq 5$.

[0021] In Bure amendment photography equipment given in any 1 term from claim 2 to claim 4, when said impact is added, invention of claim 5 It is Bure amendment photography equipment characterized by including at least one of the power-up points of said photography equipment at the focus actuation time by said photography optical system at the focal distance modification time by said photography optical system (L1-L4) the time of the flash equipment (14) with which said photography equipment is equipped popping up.

[0022]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained in more detail, referring to a drawing etc.

(The 1st operation gestalt) Drawing 1 is drawing showing the outline of the 1st operation gestalt of DSC by this invention. Drawing 2 is the block diagram of the 1st operation gestalt of DSC by this invention. In addition, the same sign is given to the part which achieves the same function as the conventional example mentioned above, and the overlapping explanation is omitted suitably. Moreover, although the Bure compensator is equipped with two control systems of pitching

yawing, since it is the same configuration, it only presupposes that it is that the suffix of p and y is attached and shown in drawing 1 , and explains by the following explanation, without summarizing both and attaching a suffix.

[0023] DSC in this operation gestalt A liquid crystal display monitor 13, flash equipment 14, the pop-up mechanical component 15, the release switch 16, a zoom lever 17, an encoder 18, DC motor 19 for zoom, the stepping motor 20 for focuses, CCD21, the Bure amendment ON/OFF switch 22, the image pick-up circuit 31, The A/D-conversion section 32, the image-processing section 33, a display and control section 34, the image storage section 35, the angular-velocity sensor 101, Maine CPU102a, Bure amendment CPU102b, driver circuits 103, 108, and 109, VCM104, optical location detection equipment 105, the amplifier filter circuit 106, It has EEPROM107, the lens groups L1-L4, etc., and is photography equipment which records the photoed still picture on record media, such as non-illustrated memory card.

[0024] A liquid crystal display monitor 13 is the display prepared in the camera tooth back, and is controlled by Maine CPU102a through the display and control section 34.

[0025] Flash equipment 14 is the so-called stroboscope luminescence equipment which emits light in a flash when required [photographic subject brightness is low, and], and illuminates a photographic subject. It is contained in the camera, and when required, flash equipment 14 is controlled by Maine CPU102a, it pops up automatically and usually emits light.

[0026] The pop-up mechanical component 15 is a mechanical component which it is controlled [mechanical component] by Maine CPU102a and pops up flash equipment 14. With this operation gestalt, when carrying out adsorption maintenance of the flash equipment 14 with the non-illustrated magnet at the time of receipt and making it pop up, it energizes in a non-illustrated coil, the magnetism of a magnet is negated, and it pops up using the energization force with a non-illustrated spring.

[0027] The release switch 16 and a zoom lever 17 are operating members used for release actuation and zooming actuation, and are connected to Maine CPU102a, respectively.

[0028] Encoders 18 are encoders, such as a photo interrupter prepared in the DC motor for zoom. The angle of rotation of DC motor 19 for zoom is detected by this encoder 18. The zoom encoder information outputted from an encoder 18 lets the zoom control section 123 pass, and is inputted into the target-position transducer 121.

[0029] DC motor 19 for zoom is a motor into which the lens groups L1-L3 are operated through the moderation device in which it does not illustrate, and a focal distance is changed. Moreover, by the drive of DC motor 19 for zoom, collapsing actuation of a lens-barrel is also possible and is come.

[0030] The stepping motor 20 for focuses is a motor which drives the lens group L4 which is a focal lens group in the direction of an optical axis, and performs focus control actuation.

[0031] CCD21 is an optoelectric transducer which picturizes electronically the image obtained by the lens groups L1-L4, and is connected to the image pick-up circuit 31.

[0032] It is the operating member function as the Bure amendment actuation authorization section which chooses and switches the Bure amendment authorized state (condition of the Bure amendment ON) to which the Bure amendment actuation is permitted, and the Bure amendment disapproval condition (condition of the Bure amendment OFF) of not permitting the Bure amendment actuation, and the Bure amendment ON/OFF switch 22 is connected to Maine CPU102a.

[0033] The image pick-up circuit 31 is a circuit which processes read in timing of CCD21 etc. Moreover, the image pick-up circuit 31 also performs control of a frame rate according to directions of Maine CPU102a. In addition, a frame rate is a count (renewal frequency of an image) by which an image is updated in 1 second, when the reading timing of CCD is generally shown, it is used, and fps (a frame/s) is used for it as a unit in many cases. It is common to use a refresh rate and to use Hz as a unit in 1 second like a frame rate, as an expression which shows the count by which an image is updated, on the other hand, when updating timing, such as a monitor display, is shown. With this operation gestalt, the refresh rate synchronizes with a frame rate, and if a frame rate is changed, it will change so that a refresh rate may synchronize.

[0034] The A/D-conversion section 32 is a part which changes the analog output from the image

pick-up circuit 31 into a digital signal, and tells Maine CPU102a and the image-processing section 33.

[0035] The image-processing section 33 is a part which performs various processings required for the display to a liquid crystal display monitor 13, and the storage to the image storage section 35 in an image. After the image displayed on a liquid crystal display monitor 13 is outputted from the image-processing section 33, it is sent to a display and control section 34 through non-illustrated VRAM (Video RandomAccess Memory). A display and control section 34 is a part which controls the display of a liquid crystal display monitor 13. Although a display and control section 34 also performs control of the refresh rate of a liquid crystal display monitor 13 according to directions of Maine CPU102a, the display and control section 34 in this operation gestalt controls as mentioned above so that a refresh rate synchronizes with a frame rate.

[0036] The image storage section 35 is a part which compresses for example, using a JPEG method etc. and memorizes the output from the image-processing section 33 to a storage etc.

[0037] The angular-velocity sensor 101 is an angular-velocity meter attached in the body of a camera. A/D conversion quantizes through the amplifier filter circuit 106, and the output of the angular-velocity sensor 101 is inputted into Bure amendment CPU102b.

[0038] CPU102 is a control section constituted by Maine CPU102a and Bure amendment CPU102b. Maine CPU102a is mainly performing the sequence of a camera, and image-processing-related processing. As mentioned above, Maine CPU102a controls the image pick-up circuit 31 and a display and control section 34, and works also as a renewal control section of an image which changes a frame rate and a refresh rate. The Bure amendment ON/OFF switch 22, the release switch 16, the zoom lever 17, the liquid crystal display monitor 13, the pop-up mechanical component 15, and the CCD21 grade are connected to Maine CPU102a.

[0039] Bure amendment CPU102b is performing control of a zoom drive, a focal drive, and the Bure amendment drive including the target-position transducer 121, the Bure amendment control section 122, the zoom control section 123, and the focal control section 124.

[0040] The zoom control section 123 is a part which controls the drive of a zoom group (L1-L3). The zoom control section 123 drives DC motor 19 for zoom through a driver circuit 109 based on the information on the zoom lever 17 sent from Maine CPU102a.

[0041] The focal control section 124 is a part which controls the drive of the lens group L4 which is a focal group based on the amount information of focal drives sent from Maine CPU102a. The amount information of focal drives sent from Maine CPU102a is told to the stepping motor 20 for a focal drive via the driver circuit 108 for stepping motors. Moreover, the amount information of focal drives is inputted into the below-mentioned target-position transducer 121.

[0042] The target-position transducer 121 is a part which computes the target-position information on the Bure correcting lens 1 based on the above-mentioned zoom encoder information, the amount information of focal drives, and the adjustment value further written in EEPROM107. The output from the target-position transducer 121 is inputted into the Bure amendment control section 122.

[0043] The Bure amendment control section 122 is a part which performs follow-up control so that the Bure correcting lens 1 may drive as the target-position information inputted from the target-position transducer 121. The output from the Bure amendment control section 122 is inputted into a driver circuit 103 as a digital driving signal. To a driving signal, a driver circuit 103 switches, carries out the seal of approval of the electrical potential difference to the coil section 3 (refer to drawing 3) of VCM104, and drives VCM104.

[0044] The location of the Bure correcting lens 1 is supervised by the below-mentioned optical location detection equipment 105, A/D conversion of the output from PSD10 (refer to drawing 3) of optical location detection equipment 105 is further carried out through non-illustrated amplifier and a low pass filter, and it is inputted into Bure amendment CPU102b. Within Bure amendment CPU102b, $(V1-V2)/(V1+V2)$ is calculated from the component both-ends outputs V1 and V2 of PSD10, the gain-adjustment value written in at the time of factory shipments is applied, and it changes into the positional information of the Bure correcting lens 1. The positional information of the changed Bure correcting lens 1 is fed back to the Bure amendment

control section 122.

[0045] Moreover, Bure amendment CPU102b is communicating at Maine CPU102a and fixed spacing. As information which communicates, there are a condition of the Bure amendment ON/OFF switch 22, a condition of the release switch 16, information from a zoom lever 17, and body sequence information. Body sequence information is the information about lens-barrel delivery initiation, collapsing initiation, flash equipment pop-up initiation, etc.

[0046] A driver circuit 103,108,109 is a circuit respectively, required since VCM104, the stepping motor 20 for focuses, and DC motor 19 for zoom are driven.

[0047] VCM104 is a voice coil motor which drives the Bure correcting lens 1. Of a driver circuit 103 and VCM104, the Bure amendment mechanical component which drives the Bure correcting lens 1 is formed. Optical location detection equipment 105 is a sensor which detects the location of the Bure correcting lens 1.

[0048] The amplifier filter circuit 106 is a circuit equipped with the low pass filter from which a noise component is removed while amplifying the signal outputted from the angular-velocity sensor 101. EEPROM107 is the non-volatile storage section which memorizes various adjustment values, such as a gain-adjustment value of optical location detection equipment 105, and the other set points.

[0049] The lens groups L1-L4 are lens groups which form photography optical system by combining these, the lens groups L1-L3 function as a zoom group, and the lens group L4 functions as a focal group. Moreover, the lens group L3 contains the Bure amendment unit, and is connected to Bure amendment CPU102b. Drawing 3 is drawing having expanded and shown the Bure amendment unit contained in the lens group L3. The Bure correcting lens 1 is the Bure amendment optical system by which caulking maintenance is carried out in the lens room 2.

[0050] The lens room 2 is a supporter holding the Bure correcting lens 1, the movable electrical-and-electric-equipment substrate 9 pastes up, and the coil 3 for driving the Bure correcting lens 1 to the movable electrical-and-electric-equipment substrate 9 is attached. The lens room 2 is held by the four springs material 8. Spring material with conductivity, such as phosphor bronze, is used for the spring material 8. It is possible to move smoothly the movable range of the direction which carries out an abbreviation rectangular cross with an optical axis by the deflection of this spring material 8 as can move like [in case there is a link mechanism] at the lens room 2. Electric supply to the above-mentioned coil 3 is performed through this spring material 8.

[0051] A magnet 4 is a permanent magnet adhered to York 5. York 5 is fixed to the right substrate 6, and the gap between a magnet 4 and a coil 3 is kept proper. The magnetic flux in a magnet 4 and the magnetic circuit constituted by York 5 will enable it to generate driving force in the direction which carries out an abbreviation rectangular cross with an optical axis, if a current is passed in a coil 3. VCM104 is formed of these coils 3, a magnet 4, and York 5.

[0052] The location of the Bure correcting lens 1 is supervised by PSD10. LED11 is attached in the electric substrate 12 fixed to the right substrate 6. The light floodlighted from LED11 passes slit 9a prepared in the movable electrical-and-electric-equipment substrate 9, and it carries out incidence on PSD10 fixed to the left substrate 7. PSD10 is the component which can detect the center-of-gravity location of light, and the center-of-gravity location of the light which carries out incidence to PSD10 by migration of slit 9a moves, and it becomes possible [detecting the location of the Bure correcting lens 1]. Optical location detection equipment 105 is formed of these slit 9a, and PSD10 and LED11.

[0053] In addition, the Bure amendment unit in this operation gestalt is not equipped with the lock device which fixes the location of the Bure correcting lens 1 so that it may understand, even if it sees drawing 3 . Therefore, the tooth space which was being used for the lock device can be used effectively, and it is small rather than DSC with the conventional lock device. Moreover, since it does not have the lock device, in not performing the Bure amendment control, the moving part containing the Bure correcting lens 1 is in the condition which can move freely in the movable range. Moreover, since spring support is carried out by the spring material 8, the moving part which consists of the Bure correcting lens 1, the lens room 2, a coil 3, and the movable electrical-and-electric-equipment substrate 9 will cause vibration with the resonant frequency decided by the mass (mass) and the spring force of moving part, if vibration is added

according to mechanical disturbance etc. The detailed explanation about this resonant frequency is mentioned later.

[0054] Next, the contents of the control which the Bure amendment control section 122 performs are explained. Drawing 4 is a block diagram explaining the control which the Bure amendment control section 122 performs. As stated also in advance, the target-position information which the target-position transducer 121 changed, and the positional information (lens positional information) of the Bure correcting lens 1 obtained from optical location detection equipment 105 are inputted into the Bure amendment control section 122.

[0055] First, PID control is explained. PID control is performed using the deflection of the target-position information on the Bure correcting lens 1, and lens positional information. First, lens positional information is subtracted from target-position information, and the multiplication of the proportionality constant K_p is carried out to the numeric value (proportional). Moreover, the result of having subtracted lens positional information from target-position information, and the information subtracted before 1 sampling are added, and the numeric value is multiplied by the integration constant K_i (integral term). Furthermore, the information subtracted before 1 sampling is subtracted from the result of having subtracted lens positional information from target-position information, and the multiplication of the differential constant K_d is carried out to the numeric value (differential term). Here, Z expresses Z transform and $1/Z$ shows the information before 1 sampling. As a result of applying the result of having hung the proportionality constant K_p , the result of having applied the integration constant K_i , and the differential constant K_d , all are added and it considers as the output of the PID-control section.

[0056] A feedforward value is calculated while performing PID control. Target-position information is multiplied by the number K_{ff} of feedforward, and it considers as a feedforward output. In this way, the acquired feedforward value and the result of an operation of PID control are added, it inputs into the electrical-potential-difference driver circuit 103 as drive Duty, and VCM104 is driven.

[0057] Next, actuation which Bure amendment CPU102b performs is explained.

(Maine sequence) Drawing 5 is a flow chart which shows the main actuation which Bure amendment CPU102b performs. In step (hereafter referred to as S) 10, a power source is turned on and it starts. In S20, DC motor 19 for zoom is driven and delivery actuation of a lens-barrel is performed. In S30, it detects whether the encoder 18 attached in DC motor 19 for zoom was supervised, the lens-barrel let out, and the location was reached. When a lens-barrel lets out and the location is arrived at, it progresses to S40, and when having not yet reached, DC motor 19 for zoom is driven until return and a lens-barrel let out to S20 and it arrives at a location. The accumulation value of an encoder 18 is reset in S40.

[0058] In S50, it judges whether the power source turns on. In addition, the monitor of this power-source condition is always performed. In the case of a power source OFF, it progresses to S60 and, in the case of a power source ON, progresses to S80. In S60, DC motor 19 for a zoom drive is driven, and collapsing actuation of a lens-barrel is performed, and it progresses to S70 and ends.

[0059] Accumulation value reading of an encoder 18 is performed in S80. Control of a zoom is also performed in Bure amendment CPU102b. When a zoom lever 17 is operated to a long focus (Tele) side, the zoom Tele direction drive command is outputted from Maine CPU102a. Moreover, when a zoom lever is operated to a short focus (Wide) side, the zoom Wide direction drive command is outputted from Maine CPU102a. In Bure amendment CPU102b, DC motor 19 for a zoom drive is driven by fixed **, and the accumulation operation of the output from an encoder 18 is performed. This accumulation operation value is read in S80. It becomes convertible into the focal distance of optical system from the accumulation value from this encoder.

[0060] In S90, focal drive step accumulation value reading is performed. In Maine CPU102a, the direction and the drive number of steps which a focus suits from the image information on CCD21 are sent to Bure amendment CPU102b. In Bure amendment CPU102b, the focal control section 124 performs delivery and drive control for a driving direction and the number of steps to the stepping motor 20 for focuses. Under the present circumstances, the accumulation operation of the sent number of steps is performed. In the Bure amendment sequence, reading of

this accumulation operation value and conversion in a focal group location are performed. Since the focal drive uses the stepping motor, it has a possibility of starting step-out with drive speed and a load. When step-out is started, a gap of a step accumulation operation value and a focal group location will arise. Therefore, in a focal drive, it is necessary to perform acceleration and deceleration so that step-out may not be started.

[0061] In S100, the condition of the Bure amendment ON/OFF switch 22 sent from Maine CPU102a is read after focal drive step accumulation value reading, and the condition of the Bure amendment ON/OFF switch 22 is judged. In the Bure amendment ON, it progresses to S200 (Bure amendment on-sequence). In the Bure amendment OFF, it progresses to S300 (Bure amendment off-sequence).

[0062] (Sequence in the Bure amendment ON) Drawing 6 is drawing showing the sequence in the Bure amendment ON. In S100 in drawing 5, when it has been recognized that a Bure amendment ON/OFF switch is ON, the Bure amendment sequence is started from S210. The Bure amendment actuation is started in S220 (Bure amendment ON).

[0063] The above-mentioned encoder accumulation value is changed into a focal distance value concrete first. Moreover, a focal drive step accumulation value is changed into a focal location. Furthermore, it changes into the target position of the Bure correcting lens 1 from the output of the value written in EEPROM107, and the angular-velocity sensor 101, and it controls so that the Bure correcting lens 1 drives to the target position. Bure amendment is performed by these actuation. In addition, even if the Bure amendment ON/OFF switch 22 is ON in the case of an interchangeable lens, unless half-push actuation of the release switch 16 is usually performed, the Bure amendment actuation is not performed. However, with this operation gestalt, the propriety of the Bure amendment actuation is decided only in the state of the Bure amendment ON/OFF switch 22.

[0064] In S230, detection of all push signals is performed after the Bure amendment ON. In all push OFF, it progresses to S290 with continuation of the Bure amendment, and escapes from the Bure amendment on-sequence. In all push ON, it progresses to S240 and shifts to the sequence at the time of photography.

[0065] Centering is performed in S240. Centering means driving the Bure correcting lens 1 almost in step to the center position (location as for which the optical axis of the Bure correcting lens 1 and the optical axis of the lens groups L1, L2, and L4 carry out abbreviation coincidence) of the movable range. In addition, the target-position wave at this time becomes able [direction] to stabilize the direction which gave inclination somewhat and to drive the Bure correcting lens 1 from a simple step configuration.

[0066] In S250, the Bure amendment control is turned ON during photography. The Bure amendment control does not use this center bias during photography to the usual Bure amendment control having always hung bias toward the core by center bias. When the Bure correcting lens 1 reaches a spilling limit, while center bias prevents a rapid motion of a lens, since target-position information is made distorted, it serves as an amendment error. Therefore, it becomes possible by not using center bias to demonstrate the amendment effectiveness to the maximum extent.

[0067] In S260, it judges whether photography was completed or not by whether the photography terminate signal obtained from Maine CPU102a is inputted. When photography is completed, it progresses to S270, and when photography is not completed, it returns to S250.

[0068] In S270, the Bure amendment is ended during photography. In S280, it changes to the usual Bure amendment (Bure amendment ON), and escapes from the Bure amendment on-sequence with continuation of the Bure amendment (S290).

[0069] (Sequence in the Bure amendment OFF) Drawing 7 is drawing showing the sequence in the Bure amendment OFF. In S100 in drawing 5, when it has been recognized that a Bure amendment ON/OFF switch is OFF, the sequence in the Bure amendment OFF is started from S310.

[0070] All push [the release switch 16] is detected in S320. When all push, it progresses to S370 and the sequence of the Bure amendment OFF is ended, and when all push, it progresses to S330.

[0071] In S330, centering is performed so that the optical axis of the Bure correcting lens 1 and the optical axis of the lens groups L1, L2, and L4 may be in agreement. With this operation gestalt, the core of the movable range of the Bure correcting lens 1 is equivalent to this location. Since the reason for performing centering excludes a lock device and constitutes the Bure amendment unit for a miniaturization, it is for raising the optical property of a lens, as the optical axis of each lens group is in agreement before photography in that which the Bure correcting lens 1 is moving in the gravity direction from the movable range core with gravity (it has fallen). In order to obtain high resolving especially, it is required to locate the optical axis of the Bure correcting lens 1 near the optical-axis core of other lens groups.

[0072] In S340, station keeping control is performed after centering. It is because the condition of having centered is held during photography and it is necessary to maintain the optical property under photography at a good condition. Moreover, there is no lock device, and when it is spring support, the Bure correcting lens 1 will move by the impact of the shutter actuation at the time of photography initiation. Also in order to prevent this, station keeping control needs to perform an electric lock and it is necessary to prevent degradation of the image by the impact.

[0073] In S350, it judges whether photography was completed or not. This judgment is made by whether a photography terminate signal goes into Bure amendment CPU102b from Maine CPU102a. When photography is not completed, return and station keeping control are continued to S340, and when photography is termination, it progresses to S360. In S360, station keeping control is ended, and it progresses to S370, and escapes from the sequence at the time of the Bure amendment OFF.

[0074] As mentioned above, with the camera in this operation gestalt, as explained, only while exposing station keeping control of the Bure correcting lens 1, during a deed and other actuation, it supposes fundamentally that station keeping control of the Bure correcting lens 1 is not performed, and power consumption is lessened. However, as stated also to explanation of the above-mentioned Bure amendment unit, with this operation gestalt, the lock device is excluded for the miniaturization. Therefore, in the condition of not performing the Bure amendment OFF and station keeping control of the Bure correcting lens 1, when an impact joins a camera, the Bure correcting lens 1 will vibrate. Since the moving part which consists of the Bure correcting lens 1 and lens room 2 grade is supported by the spring material 8, it causes vibration with the resonant frequency decided by the impact which joins a camera according to the movable mass and spring force. If the load rate of the spring of the imagination which is equivalent to m and the four springs material 8 in all the masses of moving part is set to k , it can be considered that vibration of moving part (Bure correcting lens 1 grade) is vibration of the resonant frequency f_n shown below.

$f_n = (1/2\pi) \times \sqrt{k/m}$... (formula 1)

[0075] Since the camera in this operation gestalt pops up flash equipment according to the spring energization force, an impact joins a camera at the time of pop up. Therefore, if it pops up in the Bure amendment OFF, if it remains as it is, the Bure correcting lens 1 vibrates, the image displayed on a liquid crystal display monitor 13 also shakes, and is observed, and it is unpleasant for an observer. Then, he is trying for an unnatural vibration not to appear with this operation gestalt in the image displayed on a liquid crystal display monitor 13 by considering are recording timing (frame rate = refresh rate) of the resonant frequencies f_n and CCD21 of the Bure correcting lens 1 as predetermined relation.

[0076] Drawing 8 is drawing showing migration of the image in the case of having separated from the relation which the resonant frequency f_n of the Bure correcting lens 1 and relation with a refresh rate are aiming at with this operation gestalt mentioned later, and the relation of the are recording timing of CCD21. In drawing 8, the round mark of 1-7 shows the storage time of CCD21 to the migration location of an image when flash equipment pops up. Like drawing 8, if the are recording timing of a natural period (inverse number of a resonant frequency f_n) and CCD21 is not correct, whenever the location of the image displayed is updated, it will shift greatly, and will become the display with sense of incongruity.

[0077] Drawing 9 is drawing showing migration of an image in case the resonant frequency f_n of the Bure correcting lens 1 and relation with a refresh rate (a frame rate and synchronization)

have the relation currently aimed at with this operation gestalt, and the relation of the are recording timing of CCD21. In addition, by drawing 9, in order to compare with drawing 8, the case where a refresh rate is made slightly longer than the case of drawing 8 is shown as the same as drawing 8 in the oscillatory wave form of an image position. Although the image position displayed will move with reduction of the amplitude of vibration like drawing 9 if the are recording timing of a natural period and CCD21 is correct, vibration as shown in drawing 8 is not carried out. Therefore, sense of incongruity is not given to a photography person.

[0078] In order to make natural the image displayed on a liquid crystal display monitor 13 and not to give a photography person sense of incongruity, it is required between a resonant frequency f_n (Hz) and a refresh rate f_r (Hz) to have the relation shown below (formula 2).

$|f_n - f_{rxn}| \leq 5 \dots$ (formula 2)

However, n is taken as the natural number. It is desirable to fill more preferably the relation shown below (formula 3).

$f_n = f_{rxn} \dots$ (formula 3)

If the relation of the above (formula 3) is filled, it will become the same conditions as the case of drawing 9 shown previously, and migration of the image displayed on a liquid crystal display monitor 13 will decrease most. On the other hand, by (the formula 2), as a difference of f_n and f_{rxn} , the difference to 5Hz is permitted and migration of the image displayed on a liquid crystal display monitor 13 increases more than the case where the relation of (a formula 3) is filled, in this case. However, in the usual hand deflection, a dominant frequency is 5Hz or less in frequency. Therefore, since it is almost the same as the frequency of a hand deflection even if a frequency component 5Hz or less is observed, sense of incongruity is not given to a photography person.

[0079] In addition, although explanation of drawing 8 and drawing 9 which were mentioned above explained the case where the refresh rate was being changed according to the natural frequency, you may make it adjust a natural frequency by changing the load rate of the spring material 8, and the mass of moving part. Moreover, although vibration by stroboscope pop up is raised with the above-mentioned explanation as an example, since it does not change depending on the impact to give, also when a photography person throws a camera, it is effective [the resonant frequency of moving part].

[0080] Even if it does not establish a lock device, it does not make a photography person according to this operation gestalt, sense an unpleasant shake, since it was made for the relation between the refresh rate of a liquid crystal display monitor 13 and the resonant frequency of the moving part of the Bure amendment unit to fill predetermined relation. Moreover, since it always is not necessary to carry out orientation maintenance of the Bure correcting lens 1, there is little power consumption and it can prolong a battery life.

[0081] (The 2nd operation gestalt) Since only the sequences at the time of the Bure amendment OFF which indicated the 2nd operation gestalt to be a part of Bure amendment unit in the 1st operation gestalt to drawing 7 differ, the detailed explanation about the part which is common in the 1st operation gestalt is omitted suitably. The example it is made to fill predetermined relation with the 1st operation gestalt for the resonant frequency f_n of the moving part decided from the relation between the moving part of the Bure amendment unit and the spring material 8 and the refresh rate f_r of a liquid crystal display monitor 13 was shown. However, with this operation gestalt, it does not require filling the relation (formula 2) to the 1st operation gestalt between the refresh rate displayed on a liquid crystal display monitor 13 by the normal state, and the resonant frequency f_n of moving part. About points other than this, the configuration of the Bure amendment unit in this operation gestalt is fundamentally [as the 1st operation gestalt shown in drawing 3] the same.

[0082] Next, the actuation which Bure amendment CPU102b in this operation gestalt performs is explained. Since it is the same as that of the 1st operation gestalt about the Maine sequence and the sequence in the Bure amendment ON, the sequence in the Bure amendment OFF is explained. Drawing 10 is drawing showing the sequence in the Bure amendment OFF in the 2nd operation gestalt. In S100 in drawing 5, when it has been recognized that a Bure amendment ON/OFF switch is OFF, the sequence in the Bure amendment OFF is started from S310.

[0083] In S311, the existence of the display demand corresponding to an impact is checked. When there is no display demand corresponding to an impact, it progresses to S313, and when there is a station keeping control demand, it progresses to S312. The display demand corresponding to an impact is a signal which requires that it should restrict to predetermined time amount including the time of an impact being added in the display in a liquid crystal display monitor 13, and the usual indication should be given to a different display, and it is told to Bure amendment CPU102b from Maine CPU102a.

[0084] Like the 1st operation gestalt, since the camera in this operation gestalt pops up flash equipment according to the spring energization force, an impact joins a camera at the time of pop up. Therefore, if it pops up in the Bure amendment OFF, if it remains as it is, the Bure correcting lens 1 vibrates, the image displayed on a liquid crystal display monitor 13 also shakes, and is observed, and it is unpleasant for an observer.

[0085] With this operation gestalt, since flash equipment pop up is performed by control of Maine CPU102a, popping up is expected in advance, i.e., an impact joins a camera. So, with this operation gestalt, when performing flash equipment pop up, it is supposed that the display demand corresponding to an impact is given to Bure amendment CPU102b from Maine CPU102a, and the display corresponding to an impact is performed to a liquid crystal display monitor 13.

[0086] Here, the display corresponding to an impact is explained. The 1st operation gestalt showed the example it is made for the image displayed [refresh rate / fr / the resonant frequency fn of the moving part of the Bure amendment unit and the moving part decided from the relation of the spring material 8 and / of a liquid crystal display monitor 13] on a liquid crystal display monitor 13 by making it fill in predetermined relation not to move unnaturally. However, since it both has big effect on the Bure amendment actuation itself, the spring force of the mass of the moving part of the Bure amendment unit and the spring material 8 may be unable to be adjusted according to the refresh rate fr of a liquid crystal display monitor 13. Moreover, also about the refresh rate fr of a liquid crystal display monitor 13, if it changes greatly, visibility may worsen.

[0087] Then, in such a case, this operation gestalt gives a photography person the display corresponding to an impact as a display which does not give sense of incongruity. Specifically, the refresh rate fr when performing the display corresponding to an impact is made into a different value from the refresh rate when performing the usual display. In order that the refresh rate fr when performing this display corresponding to an impact may make natural the image displayed on a liquid crystal display monitor 13 and may not give a photography person sense of incongruity, as it has the relation shown below (formula 2), it is set up between the resonant frequency fn of moving part (HZ), and a refresh rate fr (HZ).

$|fn - fr \times n| \leq 5 \dots$ (formula 2)

However, n is taken as the natural number. It is desirable to fill more preferably the relation shown below (formula 3).

$fn = fr \times n \dots$ (formula 3)

the above (formula 2) — or (formula 3) can prevent giving a photography person sense of incongruity like the 1st operation gestalt by migration of the image displayed on a liquid crystal display monitor 13, if relation is filled. When changing a refresh rate, he is trying to change the refresh rate which synchronizes with a frame rate by changing a frame rate by the image pick-up circuit 31 in this operation gestalt.

[0088] In addition, if a refresh rate is changed, the modification scale of a related circuit may become large and may lead to a cost rise. In such a case, an image just before being shocked may be displayed as it is, without drawing again the image displayed on a liquid crystal display monitor 13 as a display corresponding to an impact, or the display to a liquid crystal display monitor 13 may be vanished. In this case, while controlling by the display and control section 34 and performing the display corresponding to an impact, a frame rate and a refresh rate are not temporarily in agreement. Moreover, at the time of focal distance modification (zooming), at the time of focus actuation (focusing), the display demand corresponding to an impact is except performed, when popping up flash equipment, and powering on etc. joins and an impact joins a camera.

[0089] It returns to drawing 10 and the display corresponding to an impact is performed in S312. As mentioned above, when an impact is expected on the sequence of a camera, Maine CPU102a advances the display demand corresponding to an impact at the time of flash equipment pop up. If the display demand corresponding to an impact is advanced from Maine CPU102a, the display corresponding to an impact will be performed. This display corresponding to an impact continues the display corresponding to an impact, unless the display flag corresponding to an impact is canceled. After the time amount set up beforehand passes in flash equipment pop up, the display flag corresponding to an impact is canceled.

[0090] By performing the above-mentioned display corresponding to an impact, it is avoidable for the Bure correcting lens 1 to move by the impact expected on a sequence, and to be observed by the liquid crystal display monitor 13. Moreover, although the display corresponding to an impact is not performed when the impact which is not expected on a sequence is added, in such a case, it is the case where threw the camera or a photography person moves a camera, and a photography person does not sense unpleasant. In the display corresponding to an impact, since power is not newly needed and station keeping control of the Bure correcting lens 1 is not performed, either, power consumption can be made into the minimum.

[0091] In S313, since it is the case where there is no display demand corresponding to an impact, it usually displays. About S320-S370, it is the same as that of the sequence shown in drawing 7 in the 1st operation gestalt.

[0092] Since according to this operation gestalt the display corresponding to an impact is performed only when there is a display demand corresponding to an impact, it can prevent a display in case an impact is added moving unnaturally like at the time of pop up of flash equipment, and giving a photography person sense of incongruity.

[0093] (Deformation gestalt) Without being limited to the operation gestalt explained above, various deformation and modification are possible and they are also within the limits with equal this invention.

(1) In this operation gestalt, a camera may be DSC, and although the example which records a still picture was shown, you may be photography equipment which records not only this but an animation, and may be photography equipment which can record both a still picture and an animation.

[0094] (2) In this operation gestalt, although the lens room 2 holding the Bure correcting lens 1 mentioned as the example the Bure amendment unit of the gestalt currently held by the four springs material 8 and explained it, a gestalt which insinuates for example, not only this but a lens room according to the spring energization force to a holddown member, and moves the contact section as the sliding section is sufficient as it. Moreover, this invention is applicable even if it is the Bure amendment unit of a gestalt which does not use a spring.

[0095]

[Effect of the Invention] According to this invention, the following effectiveness can be done so as explained in detail above.

(1) Since it was made to have the relation of $|f_n - f_{rxn}| \leq 5$, even if it is the case where it does not have a lock device, when not performing the Bure amendment actuation, power consumption can be lessened without performing maintenance control to the fixed location of the Bure correcting lens as much as possible. Moreover, when vibration is transmitted according to mechanical disturbance, the image currently displayed on the liquid crystal finder, the liquid crystal display monitor, etc. can be prevented from vibrating unnaturally.

[0096] (2) When vibration is transmitted according to mechanical disturbance, the image currently displayed on the liquid crystal finder, the liquid crystal display monitor, etc. can be prevented from becoming unnatural since a display gives predetermined time amount including the time of an impact being added into the sequence of Bure amendment photography equipment, and an indication of a display to the display corresponding to an impact.

[0097] (3) A display displays the same image data as a display as a display corresponding to an impact, or since it disappears a display, it can carry out this invention easily.

[0098] (4) When vibration is transmitted according to mechanical disturbance, the image currently displayed on the liquid crystal finder, the liquid crystal display monitor, etc. can be

prevented from vibrating unnaturally, since the renewal control section of an image displays the output from an optoelectric transducer on a display as a display corresponding to an impact with the renewal frequency f_r of an image (Hz) which fills $|f_n - f_{rxn}| \leq 5$.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the outline of the 1st operation gestalt of DSC by this invention.

[Drawing 2] It is the block diagram of the 1st operation gestalt of DSC by this invention.

[Drawing 3] It is drawing having expanded and shown the Bure amendment unit contained in the lens group L3.

[Drawing 4] It is a block diagram explaining the control which the Bure amendment control section 122 performs.

[Drawing 5] It is the flow chart which shows the main actuation which Bure amendment CPU102b performs.

[Drawing 6] It is drawing showing the sequence in the Bure amendment ON.

[Drawing 7] It is drawing showing the sequence in the Bure amendment OFF.

[Drawing 8] The resonant frequency f_n of the Bure correcting lens 1 and relation with a refresh rate are drawings showing migration of the image in the case of having separated from the relation currently aimed at with this operation gestalt mentioned later, and the relation of the are recording timing of CCD21.

[Drawing 9] The resonant frequency f_n of the Bure correcting lens 1 and relation with a refresh rate are drawings showing migration of the image in the case of having the relation currently aimed at with this operation gestalt, and the relation of the are recording timing of CCD21.

[Drawing 10] It is drawing showing the sequence in the Bure amendment OFF in the 2nd operation gestalt.

[Drawing 11] It is a conceptual diagram about the deflection of a camera.

[Description of Notations]

- 1 Bure Correcting Lens
- 2 Lens Room
- 3 Coil
- 4 Magnet
- 5 York
- 6 Right Substrate
- 7 Left Substrate
- 8 Spring Material
- 9 Movable Electrical-and-Electric-Equipment Substrate
- 10 PSD
- 11 LED
- 12 Electric Substrate
- 13 Liquid Crystal Display Monitor
- 14 Flash Equipment
- 15 Pop-up Mechanical Component
- 16 Release Switch
- 17 Zoom Lever
- 18 Encoder

19 DC Motor for Zoom
20 Stepping Motor for Focuses
21 CCD
22 Bure Amendment ON/OFF Switch
31 Image Pick-up Circuit
32 A/D-Conversion Section
33 Image-Processing Section
34 Display and Control Section
35 Image Storage Section
101 Angular-Velocity Sensor
102 CPU
102a Maine CPU
102b Bure amendment CPU
103,108,109 Driver circuit
104 VCM
105 Optical Location Detection Equipment
106 Amplifier Filter Circuit
107 EEPROM
L1-L4 Lens group

[Translation done.]

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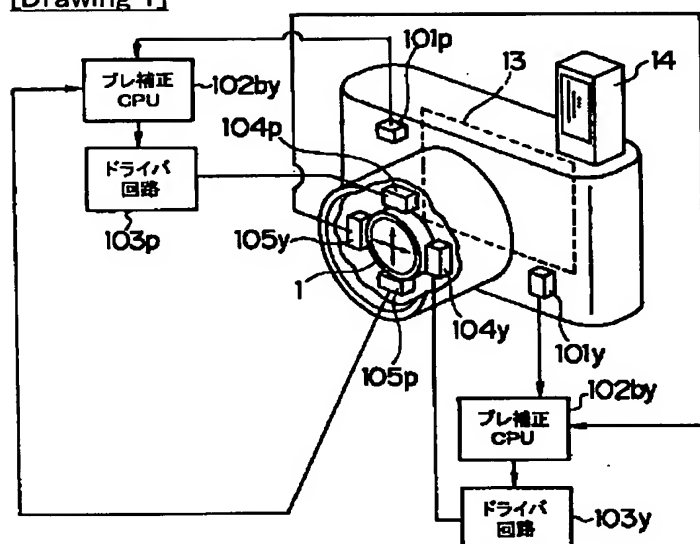
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2.*** shows the word which can not be translated.

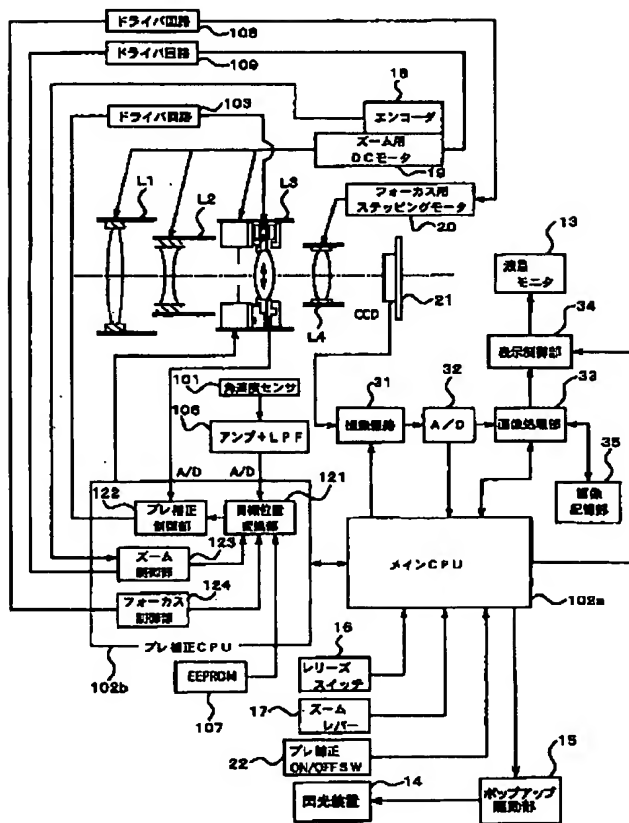
3.In the drawings, any words are not translated.

DRAWINGS

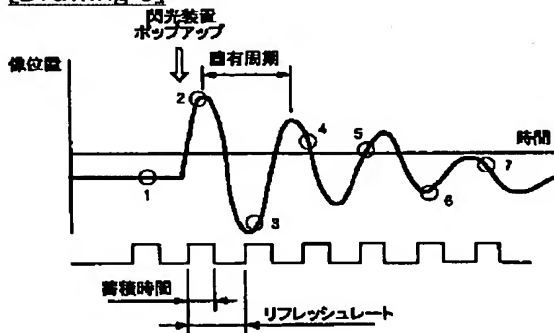
[Drawing 1]



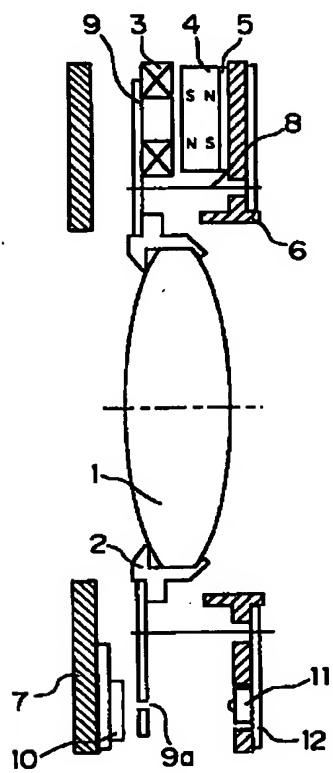
[Drawing 2]



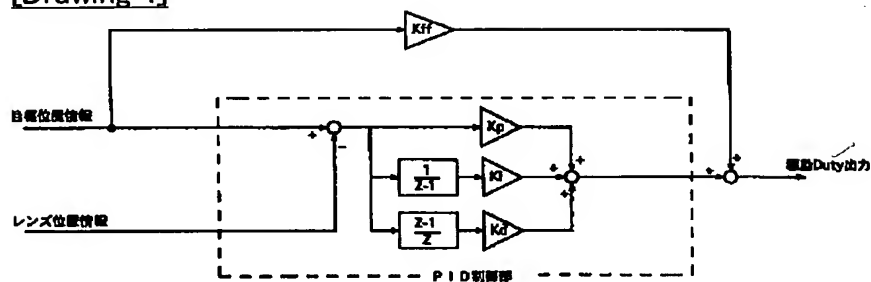
[Drawing 8]



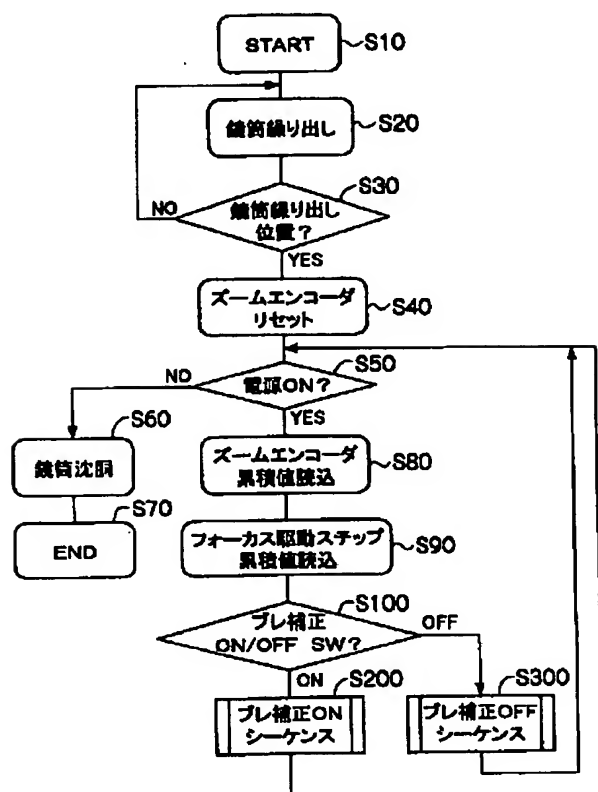
[Drawing 3]



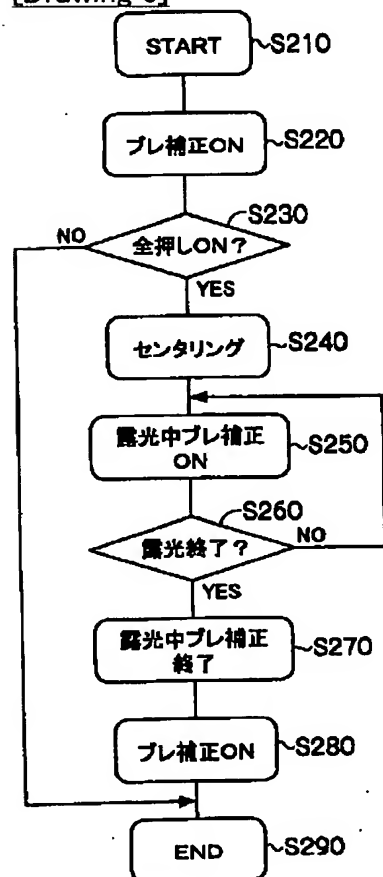
[Drawing 4]



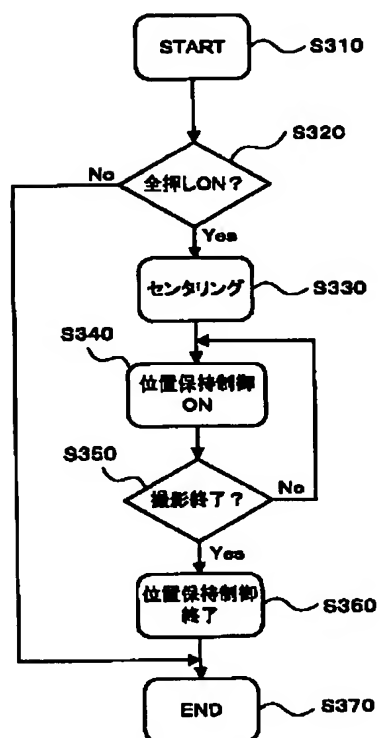
[Drawing 5]



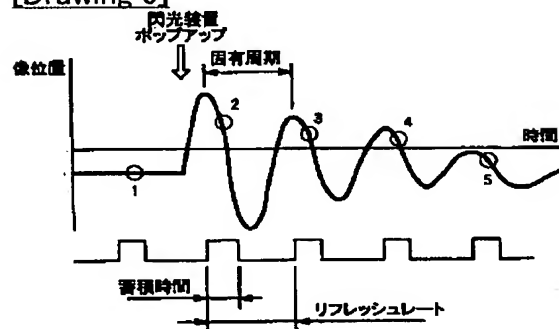
[Drawing 6]



[Drawing 7]



[Drawing 9]



[Drawing 10]



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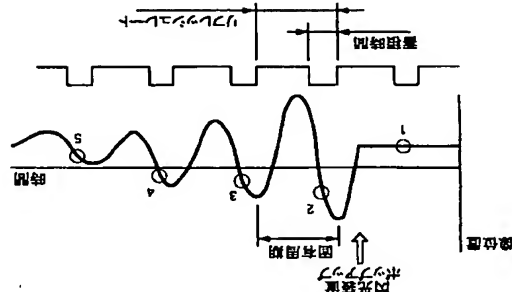
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(54)【発明の名称】 プレ補正撮影装置

(57)【要約】
【課題】 ロック機構を備えない場合であっても、プレ補正動作を行わないときに可能な限りプレ補正レンズの一定位置への保持制御を行わずに消費電力を少なくし、かつ、機械的外乱により駆動が伝わったときに、液晶フアイндаや液晶モニター等に表示されている像が不自然に振動することのないプレ補正撮影装置を確保する。
【解決手段】 プレ補正ユニットの可動部の固有振動数 f_n と液晶モニター13のリフレッシュレート f_r との間に、 $|f_n - f_r| \times n \leq 5$ 、(nは自然数)の関係が成立するようにする。このような関係に固有振動数 f_n とリフレッシュレート f_r とがあれば、例えば閃光装置がポップアップするときに、プレ補正レンズ1が振動しても、液晶モニター13に表示される像が不自然に移動すること無く、撮影者に違和感を与えることがない。



【特許請求の範囲】

【請求項1】 撮影光学系の少なくとも一部を形成し、撮影装置の撮像面におけるプレを補正するプレ補正光学系と、

前記プレ補正光学系を支持する支持部と、

前記光電変換素子により得られる数字体像を光電変換する光電変換素子と、

前記光電変換素子により得られた画像を表示する表示部と、

前記光電変換素子及び/又は前記表示部を制御して、前記光電変換時及び/又は前記表示時における画像更新周波数を求める画像更新制御部と、

を備えたプレ補正撮影装置であって、

前記画像更新周波数を f_r (H_z) とし、前記プレ補正光学系及び前記支持部からなる駆動系の固有振動数を f_n (H_z) とし、自然数を n としたときに、

$$|f_n - f_r| \times n \leq 5$$

の関係にあること、

を特徴とするプレ補正撮影装置。

【請求項2】 撮影光学系の少なくとも一部を形成し、撮影装置の撮像面におけるプレを補正するプレ補正光学系と、

前記プレ補正光学系を支持する支持部と、

前記撮影光学系により得られる数字体像を光電変換する光電変換素子と、

前記光電変換素子により得られた像を表示する表示部と、

を備えたプレ補正撮影装置であって、

前記表示部は、プレ補正撮影装置のシークエンス中に置いて駆動が加わる時点を含む所定の時間、前記表示部の表示を制御対応表示とすること、

を特徴とするプレ補正撮影装置。

【請求項3】 請求項2に記載のプレ補正撮影装置において、

前記表示部は、前記制御対応表示として、前記表示部に同じ画像データを表示する、又は、表示を消失すること、

を特徴とするプレ補正撮影装置。

【請求項4】 請求項2に記載のプレ補正撮影装置において、

前記光電変換素子及び/又は前記表示部を制御して、前記光電変換時及び/又は前記表示時における画像更新周波数を変更する画像更新制御部を備え、

前記プレ補正光学系及び前記支持部からなる駆動系の固有振動数を f_n (H_z) とし、自然数を n としたときに、画像更新制御部は、前記制御対応表示として、

$$|f_n - f_r| \times n \leq 5$$

を満たす画像更新周波数 f_r (H_z) により、前記光電変換素子からの出力を前記表示部に表示すること、

を特徴とするプレ補正撮影装置。

【請求項5】 請求項2から請求項4までのいずれか1項に記載のプレ補正撮影装置において、

前記駆動が加わる時点は、前記撮影装置に備わる閃光装置がポップアップする時点、前記撮影光学系による焦点距離変更時点、前記撮影光学系による合焦動作時点、前記撮影装置の電源投入時点の少なくとも1つを含むこと、

と、

を特徴とするプレ補正撮影装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、いわゆるデジタルステルカメラ等の内、撮影レンズの一部又は全部を動かすことにより像のプレを補正して撮影を行うプレ補正撮影装置に関するものである。

【0002】

【従来の技術】 近年、カメラにより撮影される像のプレを補正するためにカメラの振れを検知し、カメラの振れに沿って、レンズの一部を動かすことによりフィルム面上の像プレを補正する技術が確立されつつある。図1上は、カメラの振れに関する概念図である。カメラの振れは、3自由度の回転運動であるピッチング・ヨーイング・ローリング運動と、3自由度の並進運動であるX・Y・Z方向の運動とからなり、合計6自由度を有している。通常、プレ補正は、ピッチング・ヨーイングの2自由度の運動に対して行っている。

【0003】 プレ補正装置は、角速度センサ101と、CPU102と、電圧ドライバ103と、VCM104と、光学的位置検出装置105等とを備えている。なお、このプレ補正装置は、ピッチング・ヨーイングの2系統の制御系を備えているが、同様に構成できるので、図2では、p、yの添え字を付して、共通した説明を行う。

【0004】 角速度センサ101は、カメラの振れ運動を監視するセンサであり、通常、回転により生じるコリオリ力を検出する圧電振動式の角速度計を用いており、ピッチング振れ検出用の角速度計101pと、ヨーイング振れ検出用の角速度計101yの2個を使用している。

【0005】 CPU102は、角速度センサ101p、101yの出力をサンプリングし、プレ補正レンズ10の目標位置情報に変換する処理を行う部分である。この目標位置情報は、電圧ドライバ103p、103yを用いて、プレ補正ユニットの電磁駆動部であるVCM (ボイスコイルモータ) 104p、104yに入力し、プレの補正を行うように、プレ補正レンズ1を移動する。

【0006】 光学的位置検出装置105p、105yは、プレ補正レンズ1の位置を検出する部分であり、その出力は、CPU102に入力され、プレ補正レンズ1の駆動制御に用いられる。

【0007】 以上のような構成により、振れに応じてプ

レ補正レンズ1を駆動することにより、手ブレの補正を行うことができる。

【0008】ところで、近年では、フィルムを用いず、光電変換素子を撮像素子として用いる、いわゆるデジタルスチル・カメラ（以下、DSC）が増えている。DSCの場合、液晶ファインダや液晶モニタを有していることが一般的であり、また、画像の複製処理等に使用する電力も大きく、消費電力が大きいき。従って、DSCにおいては、電池寿命が問題となる場合が多く、100ショット程で電池が無くなってしまう場合も多く、消費電力を少なくすることが望まれていた。

【0009】また、DSCの場合、撮像面サイズが従来の銀塩フォーマットと比較的小さく、光学系のイメージサークルも小さくなるため、鏡筒の構成要素の小型化が可能であることがあって、DSCに対して、小型化の要求も非常に強い。

【0010】一方、DSCに対して、ブレ補正の要求も強い。これは、高併率と共に、DSCの場合、画像処理により倍率を自由に上げられる（いわゆるデジタルズーム）ためであり、例えば、光学的に8倍ズームし、更に、デジタルズームにより拡大する場がある。従って、長焦点端で手ぶれを是る可能性がより高くなっている。このような長焦点カメラにおいて、ブレ補正技術は、必須であり、上述のようなブレ補正装置がDSCへ組み込まれるようになった。

【0011】従来、ブレ補正交換レンズ用のブレ補正ユニットには、ブレ補正レンズを機械的に所定の位置に保持するためのロック機構を必要とした。これは、電源供給能力の無いカメラに対してブレ補正交換レンズを取り付けられる可能性が有り、その場合に、ブレ補正レンズの位置が不定となるからである。また、ブレ補正交換レンズに対応したカメラであっても、ブレ補正機構を動作させるない場合には、ロック機構が不動作になるのを防止するために、ロック機構が必要であった。

【0012】

【発明が解決しようとする課題】しかし、ブレ補正レンズのロック機構を設けると、鏡筒の構成要素の小型化することが困難となり、カメラが大型化するという問題があった。特に、小型化が要求されるレンズ交換のでないDSCの場合には、ロック機構を設けることにより、小型化を達成できず、問題であった。

【0013】ここで、仮に、ブレ補正レンズのロック機構を無くした場合、ブレ補正動作を許可するブレ補正許可状態（ブレ補正ONの状態）には、ブレ補正レンズを駆動するので、ブレ補正レンズの位置が不定となること無く、問題無い。しかし、ブレ補正動作を許可しないブレ補正許可可状態（ブレ補正OFFの状態）では、ロック機構を無くすとブレ補正レンズの位置が不定となり、機械的に所望の光学性能を満足することができない上に、機械的外乱等によりブレ補正レンズが駆動してし

する表示部（13）と、を備えたブレ補正撮影装置であって、前記表示部は、ブレ補正撮影装置のシーケンスタにおいて新章が加わる時点を含む所定の時間、前記表示部の表示を新章対応表示とすること、を特徴とするブレ補正撮影装置である。

【0019】請求項3の発明は、請求項2に記載のブレ補正撮影装置において、前記表示部（13）は、前記新章対応表示として、前記表示部に同じ画像データを表示する、又は、表示を消失すること、を特徴とするブレ補正撮影装置である。

【0020】請求項4の発明は、請求項2に記載のブレ補正撮影装置において、前記光電変換素子（21）及び／又は前記表示部（13）を制御して、前記光電変換素子の画像更新制御部（102a）を備え、前記ブレ補正光学系及び前記表示部からなる駆動系の固有振動数を f_n （Hz）とし、自然数を n としたときに、画像更新制御部は、前記新章対応表示として、 $|f_n - f_r \times n| \leq 5$ を満たす画像更新周波数 f_r （Hz）により、前記光電変換素子からの出力を前記表示部に表示すること、を特徴とするブレ補正撮影装置である。

【0021】請求項5の発明は、請求項2から請求項4までのいずれか1項に記載のブレ補正撮影装置において、前記新章が加わる時点は、前記撮影装置に備わる閃光装置（14）がポップアップする時点、前記撮影光学系（11～14）による焦点距離変更時点、前記撮影光学系による合焦動作時点、前記撮影装置の電源投入時点の少なくとも1つを含むこと、を特徴とするブレ補正撮影装置である。

【0022】

【発明の実施の形態】以下、図面等を参照しながら、本発明の実施の形態について、更に詳しく説明する。

（第1実施形態）図1は、本発明によるDSCの第1実施形態の概要を示す図である。図2は、本発明によるDSCの第1実施形態のブロック図である。なお、前述した従来例と同様の機能を果たす部分には、同一の符号を付して、重複する説明を適宜省略する。また、ブレ補正装置は、ピッチング・ヨーイングの2系統の制御系を備えているが、同様の構成であるので、図1において、 p 、 y の添え字を付して示すのみとし、以下の説明では、両者をまとめて添え字を付さずに説明を行う。

【0023】本実施形態における、DSCは、液晶モニタ13、閃光装置14、ポップアップ駆動部15、レリーズスイッチ16、ズームレバー17、エンコーダ18、ズーム用DSCモータ19、フォーカス用ステッピングモータ20、

請求項22、撮像回路31、A/D変換部32、画像処理部33、表示制御部34、画像記憶部35、角速度センサ101、メインCPU102a、ブレ補正CPU102b、ドライバ/回路103、108、109、VCM1

04、光学的位置検出装置105、アンプ・フィルタ回路106、EEPROM107、レンズ群L1～L4、等を備え、撮影した静止画を不図示のメモリーカード等の記録媒体に記録する撮影装置である。

【0024】液晶モニタ13は、カメラ背面に設けられた表示部であって、表示制御部34を介してメインCPU102aに制御されている。

【0025】閃光装置14は、被写体輝度が低い場合等、必要な場合に閃光を発生し、被写体を照らす。いは、カメラ内に収められており、必要ときにメインCPU102aに制御されて自動的にポップアップして発光する。

【0026】ポップアップ駆動部15は、メインCPU102aに制御されて閃光装置14をポップアップさせる駆動部である。本実施形態では、収縮時に不図示のマグネットにより閃光装置14を吸着保持しており、ポップアップさせる場合に、不図示のコイルに通電してマグネットの磁力を打ち消し、不図示のバネによる付勢力を利用してポップアップを行うようになっている。

【0027】レリーズスイッチ16、ズームレバー17は、それぞれ、レリーズ操作、ズーム操作に使用する操作部材であり、メインCPU102aに接続されている。

【0028】エンコーダ18は、ズーム用DSCモータに設けられているフォトインタラプタ等のエンコーダである。このエンコーダ18によりズーム用DSCモータ19の回転角が検出される。エンコーダ18から出力されるズームエンコーダ情報は、ズーム制御部123を通し、目標位置変換部121に入力される。

【0029】ズーム用DSCモータ19は、不図示の減速機構を介してレンズ群L1～L3を操作し、焦点距離を変えるモータである。また、ズーム用DSCモータ19の駆動により鏡筒の近動動作も可能となっている。

【0030】フォーカス用ステッピングモータ20は、フォーカスレンズ群であるレンズ群L4を光軸方向に駆動し、焦点調整動作を行うモータである。

【0031】CDD21は、レンズ群L1～L4により得られる像を電子的に撮像する光電変換素子であり、撮像回路31に接続されている。

【0032】ブレ補正ON/OFFスイッチ22は、ブレ補正動作を許可するブレ補正許可状態（ブレ補正ONの状態）と、ブレ補正動作を許可しないブレ補正不許可状態（ブレ補正OFFの状態）とを選択して切り換えるブレ補正動作許可部として機能する操作部材であり、メインCPU102aに接続されている。

【0033】撮像回路31は、CDD21の読み込みタイミング等の処理を行う回路である。また、撮像回路31は、メインCPU102aの指示に従い、フレームレートの制御も行。なお、フレームレートは、1秒間に画

駆動を行う。S40では、エンコーダ18の累積値をリセットする。

【0058】S50では、電圧がONしているか否かの判断を行う。なお、この電圧状態の監視は、常時行っている。電源OFFの場合、S60に進み、電源ONの場合は、S80に進む。S60では、ズーム駆動用DCモータ19を駆動し、鏡筒の駆動動作を行い、S70に進み終了する。

【0059】S80では、エンコーダ18の累積値設定を行う。ブレ補正CPU102bでは、ズームの制御が行っている。ズームレバー17を焦点点(Tele)側に操作した場合、メインCPU102aよりズームAwdirection駆動指令が出力される。ブレ補正CPU102bでは、ズーム駆動用DCモータ19を一定速で駆動し、エンコーダ18からの出力の累積演算を行っている。S80では、この累積演算値の設定を行う。このエンコーダからの累積値から光学系の焦点距離への変換が可能となる。

【0060】S90では、フォーカス駆動ステップ累積値設定を行う。メインCPU102aでは、CCD21の像情報からピントの合う方向と駆動ステップ数をブレ補正CPU102bに送る。ブレ補正CPU102bでは、フォーカス制御部124によりフォーカス用ステップ駆動モータ20へ駆動方向とステップ数を送り、駆動制御を行う。この際、送ったステップ数×累積演算値を行フォーカス評価値への交換を行う。フォーカス駆動は、ステップモータを用いているため、駆動スピード及び負荷により脱調を起こす恐れがある。脱調を起こした場合、ステップ累積演算値とフォーカス評価値のずれが生じてしまう。したがって、フォーカス駆動においては、脱調を起こさないよう加速減速を行う必要がある。

【0061】S100では、フォーカス駆動ステップ累積値設定の後、メインCPU102aより送られるブレ補正ON/OFFスイッチ22の状態を読み込み、ブレ補正ONの場合は、S200(ブレ補正ONシーケンス)へ進む。ブレ補正OFFの場合は、S300(ブレ補正OFFシーケンス)へ進む。

【0062】(ブレ補正ONの場合のシーケンス) 図6は、ブレ補正ONの場合のシーケンスを示す図である。図5におけるS100において、ブレ補正ON/OFFスイッチがONであることを認識した場合、S210からブレ補正シーケンスを開始する。S220では、ブレ補正動作を開始する(ブレ補正ON)。

【0063】具体的に、まず、前述のエンコーダ累積値を焦点距離値に変換する。また、フォーカス駆動ステップ累積値をフォーカス位置に変換する。更に、EEPROM107に書き込まれた値及び外連センサ101の出力からブレ補正レンズ1の目標位置に変換し、その目標位置にブレ補正レンズ1が駆動されるように制御を行う。これらの動作によりブレ補正が実行される。なお、通常、交換レンズの場合、ブレ補正ON/OFFスイッチ22がONであっても、リリーススイッチ16の半押し動作を行わない限り、ブレ補正動作を行わない。しかし、本実施形態では、ブレ補正ON/OFFスイッチ22の状態のみでブレ補正動作の可否を決める。

【0064】S230では、ブレ補正ONの後、全押し信号の検出を行う。全押しOFFの場合、ブレ補正継続のままS290に進み、ブレ補正ONシーケンスを放ける。全押しONの場合、S240に進み、撮影時のシーケンスへ移行する。

【0065】S240では、センタリングを行う。センタリングとは、ブレ補正レンズ1を可動範囲の中心位置(ブレ補正レンズ1の光軸と、レンズ群L1、L2、L4の光軸とが一致する位置)へほぼステップ的に駆動することをいう。なお、このときの目標位置情報は、単純なステップ形状より多少の配位を持たせた方がブレ補正レンズ1を安定して駆動することが可能となる。

【0066】S250では、撮影中ブレ補正制御をONにする。通常のブレ補正制御は、センタリングにより常に中心に向かってバイアスを掛けていたのに対し、撮影中ブレ補正制御は、このセンタリングを用いない。センタリングは、ブレ補正レンズ1が可動範囲に達した際、レンズの急激な動きを防ぐ反面、目標位置情報を歪ませているため補正精度となる。したがって、センタリングを用いないことにより補正効果を最大限に発現することが可能となる。

【0067】S260では、メインCPU102aより得られる撮影終了信号が入力されるか否かにより、撮影が終了したか否かを判断する。撮影が終了している場合、S270に進み、撮影が終了していない場合、S250に戻る。

【0068】S270では、撮影中ブレ補正を終了する。S280では、通常のブレ補正に切り替え(ブレ補正ON)、ブレ補正継続のままブレ補正ONシーケンスを放ける(S290)。

【0069】(ブレ補正OFFの場合のシーケンス) 図7は、ブレ補正OFFの場合のシーケンスを示す図である。図5におけるS100において、ブレ補正ON/OFFスイッチがOFFであることを認識した場合、S310からブレ補正OFFの場合のシーケンスを開始する。

【0070】S320では、リリーススイッチ16が全押しされたか否かを検出する。全押しされていない場合には、S370に進み、ブレ補正OFFのシーケンスを終了し、全押しされている場合には、S330に進む。【0071】S330では、ブレ補正レンズ1の光軸

と、レンズ群L1、L2、L4の光軸とが一致するように、センタリングを行う。本実施形態では、ブレ補正レンズ1の可動範囲の中心がこの位置に相当している。センタリングを行う理由は、小型化のために、ロッキングを省きブレ補正ユニットを構成している中で、撮影前に、ブレ補正レンズ1が重力により可動範囲中心から直方方向に移動している(落ちている)のを、各レンズ群の光軸が一致するようにして、レンズの光学特性を向上させるためである。特に、高倍率を得るためには、ブレ補正レンズ1の光軸を、他のレンズ群の光軸中心付近に位置させることが必要である。

【0072】S340では、センタリングの後、位置保持制御を行う。撮影中は、センタリングした状態を保持しておき、撮影中の光学特性をよい状態に保つ必要があるからである。また、ロッキング機構が無く、バネ支持の場合、撮影開始時のシャッター動作の衝撃によりブレ補正レンズ1が動いてしまう。これを防ぐために、位置保持制御により電気的ロックを行い、衝撃による像の劣化を防ぐ必要がある。

【0073】S350では、撮影が終了したか否かの判断を行う。この判断は、メインCPU102aよりブレ補正CPU102bに撮影終了信号が入るか否かにより行われる。撮影が終了していない場合、S340に戻る。撮影が終了している場合、S360に進み、位置保持制御を終了し、撮影が終了していない場合、S370に進み、ブレ補正OFF時のシーケンスを放ける。

【0074】以上、説明したように、本実施形態におけるカメラでは、ブレ補正レンズ1の位置保持制御を露光中ののみ行い、その他の動作中は、基本的には、ブレ補正レンズ1の位置保持制御を行わないこととし、消費電力を少なくしている。しかし、前述のブレ補正ユニットの説明にも述べたように、本実施形態では、小型化のためにロッキング機構を省いている。したがって、ブレ補正OFFかつブレ補正レンズ1の位置保持制御を行わない状態で、カメラに衝撃が加わると、ブレ補正レンズ1が振動することとなる。ブレ補正レンズ1、レンズ群2等から成る可動部は、バネ材8により支持されているので、カメラに加わる衝撃によりその可動マスとバネ力により決まる固有振動数で振動を起こす。可動部の全てのマスをm、4本のバネ材8に相当する位置のバネのバネ定数をkとすると、可動部(ブレ補正レンズ1等)の振動は、以下に示す固有振動数f_nの振動とみなすことができる。

$$f_n = (1/2\pi) \times \sqrt{(k/m)} \dots (式1)$$

【0075】本実施形態におけるカメラは、閃光装置のポップアップをバネ付勢力により行うので、ポップアップ時にカメラに衝撃が加わる。したがって、ブレ補正OFFの場合にポップアップを行うと、そのままではブレ補正レンズ1が振動して、液晶モニタ13に表示される像も揺れて観察され、観察者にとって不快である。そこで、

で、本実施形態では、ブレ補正レンズ1の固有振動数f_nと、CCD21の蓄積タイミング(フレームレート=リフレッシュレート)とを所定の関係とすることにより、液晶モニタ13に表示される像に自然な振動が現れないようにしている。

【0076】図8は、ブレ補正レンズ1の固有振動数f_nと、リフレッシュレートとの関係が、後述する本実施形態で狙っている関係から外れている場合の像の移動とCCD21の蓄積タイミングの関係を示す図である。図8では、閃光装置がポップアップしたときの像の移動位置に、CCD21の蓄積時間を1〜7の丸印により示している。図8のように、固有周期(固有振動数f_nの逆数)とCCD21の蓄積タイミングが合っていないと、表示される像の位置が、更新される毎に大きくずれてしまい、違和感のある表示となってしまう。

【0077】図9は、ブレ補正レンズ1の固有振動数f_nと、リフレッシュレート(フレームレートと同値)とを、本実施形態で狙っている関係にある場合の像の移動とCCD21の蓄積タイミングの関係を示す図である。なお、図9では、図8と比較するために、像位置が移動するが、図8に示したような振動をすることがない。したがって、撮影者に違和感を与えることもない。

【0078】液晶モニタ13に表示される像を自然にしたい、撮影者に違和感を与えないためには、固有振動数f_n(Hz)とリフレッシュレートf_r(Hz)との間に、以下に示す(式2)の関係にあることが必要である。

$$f_n - f_r \times n \leq 5 \dots (式2)$$

ただし、nは、自然数とする。より詳しくは、以下に示す(式3)の関係を満たすことが望ましい。

$$f_n = f_r \times n \dots (式3)$$

上記(式3)の関係を満たせば、先に示した図9の場合と同様な条件となり、液晶モニタ13に表示される像の移動は、最も少なくなる。一方、(式2)では、f_nとf_r×nとの差として、5Hzまでの差を許容しており、この場合は、(式3)の関係を満たす場合よりも、液晶モニタ13に表示される像の移動が多くなる。しかし、通常の手振れにおいて支配的な周波数は、5Hz以下で、5Hz以下の周波数成分が観察されたとしても、手振れの周波数とほぼ同じであることから、撮影者に違和感を与えることがない。

【0079】なお、上述した図5及び図9の説明では、固有振動数に合わせてリフレッシュレートの変更を行っている場合を説明したが、バネ材8のバネ定数や可動部の質量を変更することにより、固有振動数を調整するようにしてもよい。また、上記説明では、ストロボが

プアップによる振動を例としてあげているが、可動部の固有振動数は、与える衝撃によっても、変化しないので、撮影者がカメラをぶつけたような場合にも有効である。

【0080】本実施形態によれば、液晶モニタ13のリフレッシュレートとブレ補正CPU102の可動部の固有振動数との関係が、所定の関係を満たすようにしたことで、ロック機構を設けなくても、撮影者に不快な揺れを感じさせることがない。また、ブレ補正レンズ1を常に定位駆動保持する必要がないので、消費電力が少なく、電池寿命を延ばすことができる。

【0081】(第2実施形態) 第2実施形態は、第1実施形態におけるブレ補正ユニットの一部と、図2に示したブレ補正OFF時のシーケンスのみが異なるので、第1実施形態と共通する部分についての詳細な説明は、適宜省略する。第1実施形態では、ブレ補正ユニットの可動部及びバネ材8の関係から決まる可動部の固有振動数 $f(n)$ と、液晶モニタ13のリフレッシュレート $f(r)$ とを、所定の関係を満たすようにする例を示した。しかし、本実施形態では、液晶モニタ13に通常状態で表示されるリフレッシュレートと、可動部の固有振動数 $f(n)$ との間には、第1実施形態における(式2)の関係と等しいことを要しない。これ以外の点については、本実施形態におけるブレ補正ユニットの構成は、図3に示した第1実施形態と基本的に同様である。

【0082】次に、本実施形態におけるブレ補正CPU102bが行う動作について、説明する。メインシーケンス及びブレ補正ONの場合のシーケンスについては、第1実施形態と同様であるので、ブレ補正OFFの場合のシーケンスについて説明を行う。図10は、第2実施形態におけるブレ補正OFFFの場合のシーケンスを示す図である。図5におけるS100において、ブレ補正ON/OFFスイッチがOFFであることを認識した場合、S310からブレ補正OFFFの場合のシーケンスを開始する。

【0083】S311では、衝撃対応表示要求の有無を確認する。衝撃対応表示要求が無い場合には、S313に進み、位置保持制御要求が有る場合には、S312に進む。衝撃対応表示要求と、液晶モニタ13における表示を、衝撃が加わる時点を含む所定の時間1周り通常表示と、衝撃が加わる表示とすることを要求する(図9)であり、メインCPU102aからブレ補正CPU102bに伝えられる。

【0084】第1実施形態と同様に、本実施形態におけるカメラでは、閃光装置のポップアップをバネ材8により行うので、ポップアップ時にカメラに衝撃が加わる。したがって、ブレ補正OFFFの場合にポップアップを行うと、そのままではブレ補正レンズ1が振動して、液晶モニタ13に表示される像も揺れて観察され、観察者に不快感である。

た、衝撃対応表示要求は、閃光装置のポップアップを行うとき以外に、焦点距離変更(ズームイン)時、合焦動作(フォーカシング)時、電源投入等、カメラに衝撃が加わる時点に行われる。

【0089】図10に戻って、S312では、衝撃対応表示を行う。上述したように、カメラのシーケンス上で衝撃が予想されるとき、例えば図4実施例ポップアップ時に、メインCPU102aは、衝撃対応表示要求を出す。メインCPU102aから衝撃対応表示要求が出されると、衝撃対応表示を行う。この衝撃対応表示は、衝撃対応表示フラグが解除されない限り衝撃対応表示を続ける。閃光装置ポップアップの場合には、予め設定された時間が経過した後、衝撃対応表示フラグが解除される。

【0090】上述の衝撃対応表示を行うことにより、シーケンス上で予想される衝撃によりブレ補正レンズ1が動いて、液晶モニタ13により観察されてしまうことを回避できる。また、シーケンス上で予想されない衝撃が加わる場合には、衝撃対応表示を行わないが、そのような場合とは、カメラをぶつけた時、撮影者がカメラを動かしたりした場合であり、撮影者が不快に感じることがない。衝撃センサでは、新たに感力が必要とせず、ブレ補正レンズ1の位置保持制御も行わないので、消費電力を最小限とすることができる。

【0091】S313では、衝撃対応表示要求が無い場合なので、通常表示を行う。S320～S370については、第1実施形態における図7に示したシーケンスと同様である。

【0092】本実施形態によれば、衝撃対応表示要求があるときにのみ、衝撃対応表示を行うので、閃光装置のポップアップ時等のときに、衝撃が加わる時の表示が不自然に移動して、撮影者に違和感を与えることを防止することができる。

【0093】(変形形態) 以上説明した実施形態に限定されことなく、種々の変形や変更が可能であって、それらも本発明の均等の範囲内である。

(1) 本実施形態において、カメラはDSFCであった、静止画を記録する例を示したが、これに限らず、例えば、動画を記録する撮影装置であってもよいし、静止画と動画の両方を記録することができる撮影装置であってもよい。

【0094】(2) 本実施形態において、ブレ補正レンズ1を保持するレンズ筐2は、4本のバネ材8により保持されている形態のブレ補正ユニットを例に挙げて説明したが、これに限らず、例えば、レンズ筐を固定部材に対してバネ材9により当り当て付け、当該部材を揺動して移動するような形態でもよい。また、バネを用いない形態のブレ補正ユニットであっても、本発明を適用することができる。

【0095】

【発明の効果】以上詳しく説明したように、本発明によれば、以下の効果を奏することができる。

(1) $|f(n) - f(r) \times n| \leq 5$ の関係にあるようにしたので、ロック機構を備えない場合であっても、ブレ補正動作を行わないときに可能な限りブレ補正レンズの一定位置への保持制御を行わずに消費電力を少なくすることができる。また、機械的外乱により振動が伝わったときに、液晶フラインダや液晶モニタ等に表示されている像が不自然に振動しないようにすることができる。

【0096】(2) 表示部は、ブレ補正撮影装置のシーケンス中において衝撃が加わる時点を含む所定の時間、表示部の表示を衝撃対応表示とするので、機械的外乱により振動が伝わったときに、液晶フラインダや液晶モニタ等に表示されている像が不自然にならないようにすることができる。

【0097】(3) 表示部は、衝撃対応表示として、表示部に同じ画像データを表示する。又は、表示を消失するので、簡単に本発明を実施することができる。

【0098】(4) 画像更新制御部は、衝撃対応表示として、 $|f(n) - f(r) \times n| \leq 5$ を満たす画像更新周波数 $f(r)(Hz)$ により、光電変換素子からの出力を表示部に表示するので、機械的外乱により振動が伝わったときに、液晶フラインダや液晶モニタ等に表示されている像が不自然に振動しないようにすることができる。

【図面の簡単な説明】
【図1】 本発明によるDSFCの第1実施形態の概要を示す図である。
【図2】 本発明によるDSFCの第1実施形態のブロック図である。

【図3】 レンズ筐13に含まれているブレ補正ユニットを拡大して示した図である。
【図4】 ブレ補正制御部122が行う制御を示すブロック図である。

【図5】 ブレ補正CPU102bが行う主要動作を示すフローチャートである。
【図6】 ブレ補正ONの場合のシーケンスを示す図である。

【図7】 ブレ補正OFFFの場合のシーケンスを示す図である。
【図8】 ブレ補正レンズ1の固有振動数 $f(n)$ と、リフレッシュレートとの関係が、後述する本実施形態で組んでいる関係から外れている場合の像の移動とCCD21の蓄積タイミングの関係を示す図である。

【図9】 ブレ補正レンズ1の固有振動数 $f(n)$ と、リフレッシュレートとの関係が、本実施形態で組んでいる関係にある場合の像の移動とCCD21の蓄積タイミングの関係を示す図である。

【図10】 第2実施形態におけるブレ補正OFFFの場合のシーケンスを示す図である。
【図11】 カメラの取扱いに関する断面図である。

【符号の説明】

- | | | | |
|---|-----------|---------------|-----------------|
| 1 | ブレ補正レンズ | 20 | フォーカス用ステッピングモータ |
| 2 | レンズ蓋 | 21 | CCD |
| 3 | コイル | 22 | ブレ補正ON/OFFスイッチ |
| 4 | マグネット | 31 | 撮像回路 |
| 5 | ヨーク | 32 | A/D変換部 |
| 6 | 右基板 | 33 | 画像処理部 |
| 7 | 左基板 | 34 | 表示制御部 |
| 8 | パネル材 | 35 | 画像記憶部 |
| 9 | 可動電気基板 | 101 | 角速度センサ |
| 0 | PSD | 102 | CPU |
| 1 | LED | 102a | メインCPU |
| 2 | 電気基板 | 102b | ブレ補正CPU |
| 3 | 液晶モニタ | 103, 108, 109 | ドライバ回路 |
| 4 | 光学置 | 104 | VCM |
| 5 | ポツアアップ駆動部 | 105 | 光学的位置検出装置 |
| 6 | リーダスウィッチ | 106 | アンプ・フィルタ回路 |
| 7 | ズームレバー | 107 | EEPROM |
| 8 | エンコーダ | L1~L4 | レンズ群 |

